THE ALBERTA OIL SANDS - CANADA'S ENERGY CHALLENGE

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INTRODUCTION

With the growing energy shortages facing many countries today and particularly Canada and the U.S.A., it is imperative that we in Canada focus our attention on new potential reserves for alternate energy supplies. There are many possible sources available but the Alberta Oil Sands are probably the nearest to being ready for commercial development, thanks to a lot of hard work by a lot of very dedicated people like Dr. Karl A. Clark and companies with great determination and foresight like Great Canadian Oil Sands Limited and Syncrude Canada Limited.

RESERVES AND RECOVERIES

The oil sands deposits have been known for centuries and have interested the white man from the days of the earliest fur traders and explorers. In total the four major deposits cover an area of over nineteen thousand (19,000) square miles and contain approximately one trillion barrels of in-place oil and are one of the worlds largest resources of hydrocarbons. The largest accumulation, the Athabasca deposit, outcrops along the Athabasca River and extends down-dip to the south and west to an overburden depth of about two thousand (2,000) feet. The other Alberta deposits, Peace River, Wabasca and Cold Lake are smaller in size and together contain about one half the amount of oil in the Athabasca deposit. Small sections of the Athabasca deposit only are suitable for open-pit recovery methods, but potential recoverable synthetic crude oil from these mineable sections amounts to 26.5

billion barrels. This is small in comparison to the total potential recovery from the entire deposits but still some 3 - 4 times the amount of the present total Canadian conventional crude oil reserves. Possible in-situ recoveries from the tar sands total 250 billion barrels or more and could last Canada for hundreds of years at present rate of consumption.

THE CHALLENGE

With such an incentive as an assured supply of energy we can afford to spend extra time and effort in order to achieve the required production to relieve the impending shortage. The challenge is to develop the technology to produce enough oil at a reasonable market value and at the same time conserve the environment. This requires development of more sophisticated mining and extraction procedures, developing and proving up in-situ techniques and optimizing upgrading processes to give maximum yields of usable product from the bitumen recovered.

TAR SANDS PROPERTIES AND RESEVOIR CHARACTERISTICS

The Alberta deposits have been evaluated by the drilling of over 4000 wells, by extensive laboratory and field experimental work directed towards development of both mining and in-situ methods and by the work at The Great Canadian Oil Sands Limited mining project on a commercial scale. The oil sands are composed of a series of quartz sand deposits impregnated with varying amounts of a heavy, highly viscous bitumen. The sands are deposited on an irregular surface of limestone or shale and are generally overlain with overburden, varying in thickness from zero to two thousand feet. The bitumen has an API gravity of about 7 degrees and contains 5 or more weight percent sulphur and is relatively high in metals. The deposit is highly compacted and temperature within the ore body remains fairly constant at about 6° C. At this temperature the bitumen has a viscosity so high that it is immobile. Relatively little is known of the

physical characteristics and behaviour of the ore body and much work must be done to determine more of the characteristics and properties in order to improve on mining technizues and develop viable in-situ processes.

OPEN PIT MINING

The only current commercial production from the oil sands is from the Great Canadian Oil Sands plant north of Fort McMurray in the Athabasca deposit, where yields have been running about 50,000 B.P.D. during the past several years. Syncrude Canada Limited is building a plant with planned production capacity of 100,000 B.P.D. by the early 1980's. Both operations require removal of tree growth, muskeg and remaining overburden before mining the tar sand for transporation to the extraction plant for bitumen recovery. The bitumen requires desulphurizing and upgrading. before it is suitable for pipeline shipment as refinery feed stock. The basic procedures in both plants are similar and vary in operating detail only.

Both operations face or will face several major problems which require solving before it can be said that the open pit mining method is completely successful.

The sludge problem with its high attendent cost of overburden removal and dyke building remains the greatest single obstacle to the success of the Great Canadian Oil Sands operation. Sludge accumulation and build-up requires the construction of hugh retaining basins which are constructed from selected suitable portions of the overburden layers. This requires the special handling, transportation, spreading and compaction of huge volumes of this material yearly which adds to the costs and does not give a final solution to the problem. The obvious answer of course, is to discover a simple inexpensive method for breaking this "emulsion" of clay, water, bitumen and residual caustic.

Upgrading and desulphurizing require high cost capital equipment which is relatively expensive to operate. Yields from the current up-

grading operation are relatively low at 76%. Coke production is about twenty-eight percent and only a portion is burned as fuel and the rest stockpiled. Syncrude Canada Limited will install upgrading facilities that will improve the liquid product yield but coke production will be stockpiled because of its high sulphur content. Improved or new upgrading processes are required that will give higher liquid yields from the recovered bitumen and produce a balanced slate of products which utilizes 100% of the bitumen barrel. Stockpiling of coke can, at best, be only a temporary measure until such times as we learn how to take full advantage of production. Both projects make use of sizeable volumes of natural gas for the production of hydrogen which is used in the upgrading processes. Government authorities have indicated that the use of natural gas for such purposes in the future will be restricted and other sources of raw material (coke) must be utilized for hydrogen production.

IN-SITU

Many experimental projects have been conducted in the in-situ mode of operation in most areas of the oil sands deposits with varying results. One developer has a long standing project in operation in the Cold Lake deposit which is showing signs of success, although recoveries reported are as low as 7%. This may be satisfactory for initial pilot work but for long range operation this will not satisfy the conservation authorities. Other pilot projects have been carried out and claim better recoveries but these have not had the advantage of long term and sustained production. Up to this point there are no projects that can be classified as commercial or even semi-commercial but several claim an optimistic outlook for the future. To a large extent these pilot projects have been conducted in secret and there appears to be a measure of duplication from project to project. The projects all utilize some means to mobilize the oil by reducing the viscosity. Introduction of heat by injection of steam or hot gasses

or by partial combustion of the bitumen in place are the major processes involved. Some utilize a solvent method for recovery but usually this has the shortcoming of major solvent losses in the process. Other pilots employ a combination of two or more methods and show some promise for the future.

THE ENVIRONMENT AND AOSERP

One of the major concerns in any process that may be utilized in developing this huge resource is the effect on the environment. Mining processes disturb large areas that must be rehabilitated and restored to acceptable condition. In-situ also disturbs some land area but considerably less than mining processes, nonetheless restoration must be considered. Both methods run the risk of water contamination and provisions must be made to assure that pollution is minimized. Upgrading operations from both methods can produce air pollution through sulphur and particulates emissions to the atmosphere and require an enormous amount of work so that new plants can remain within the strict Alberta standards.

One major problem facing environmental authorities has always been in setting realistic and meaningful standards. There has never been sufficient base data on which standards could be set. The Canadian Federal and Alberta Provincial Governments have combined in setting up a research program "directed to the practical solution of environmental problems resulting from oil sands development, and to the provision of scientific data for the use of government, industry and the public". The program will develop a comprehensive data base and background information for the formulation of an acceptable environmental program.

DEVELOPING THE TECHNOLOGY

The Alberta Government has set up the "Alberta Oil Sands Technology and Research Authority" to develop the technology needed to establish a commercial in-situ method of oil sands recovery in Alberta. In addition it has been charged with the responsibility to investigate means to improve the surface mining technology particularly those having potential for reducing capital costs, for increasing the efficiency of separation and upgrading, or having improved environmental features. Methods for underground mining will also be investigated.

Since open pit mining and upgrading procedures have been developed and are in a relatively advanced stage, priority is being given to in-situ technology development. Applications have been received for funding in all areas of potential development and all are being considered. The in-situ applications have been reviewed and several have been selected for approval pending the successful negotiations with the applicant. The approved projects will be funded generally on a 50:50 basis with AOSTRA and industry being equal partners but with the Authority retaining the ownership of the technology developed.

Such a program should speed up the development of the in-situ technology and know-how, it should avoid wide spread duplication of effort and minimize overexpenditure of dollars and make available the technology at a reasonable cost for major tar sand development in in-situ areas.

Other technological developments in underground mining, upgrading, improvements in surface mining processes and environmental areas are being considered as time permits.

THE FUTURE

The development of the tar sand industry is only beginning and we are only now realizing the number of problems and the magnitude of these problems to be overcome before we can say that we have a viable tar sands industry. The Federal and Provincial Governments are beginning to realize that this is a challenge worth facing and are beginning to show more active support. Industry has been attempting to develop the needed technology but it has been a slow process. With combined government/industry effort progress should be more quickly achieved and some of our problems solved.